

(43) Date of A Publication 13.10.1999

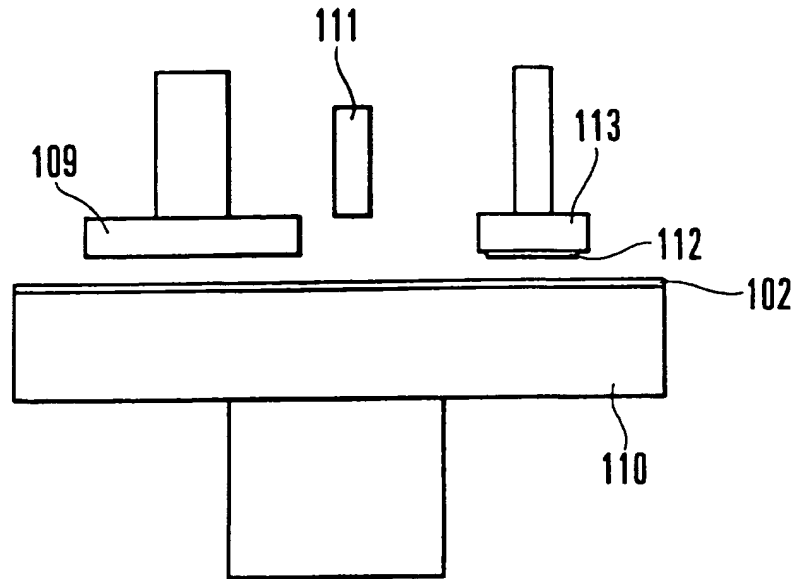


FIG. 1A

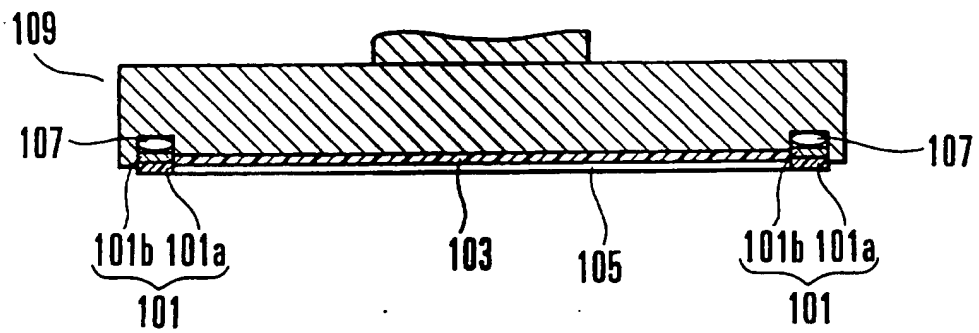


FIG. 1B

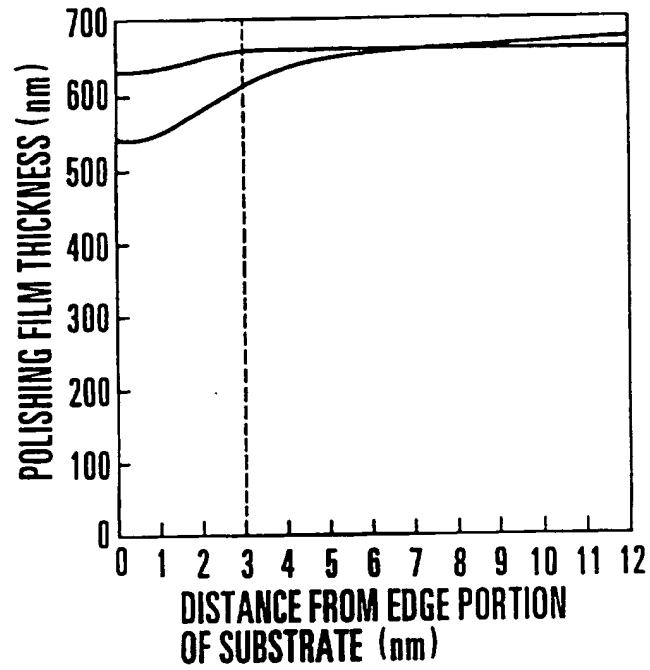


FIG. 2

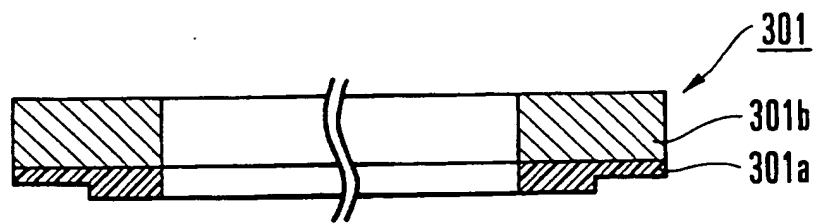


FIG. 3A

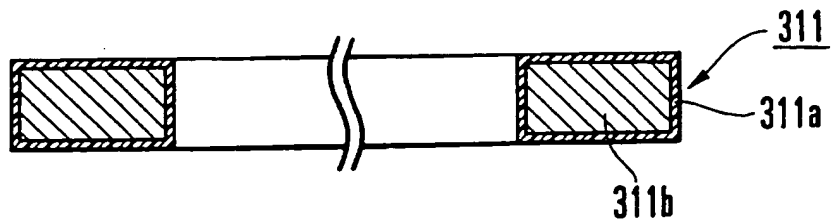


FIG. 3B

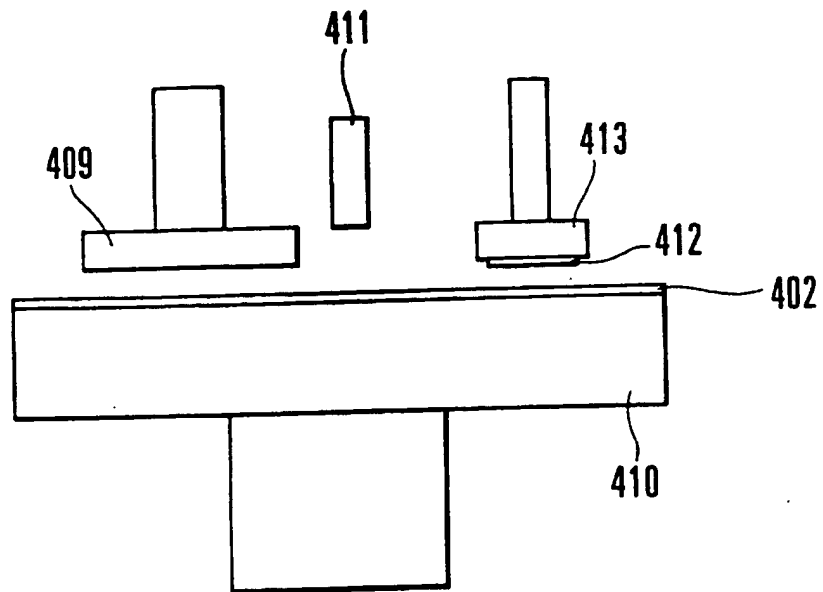


FIG. 4A

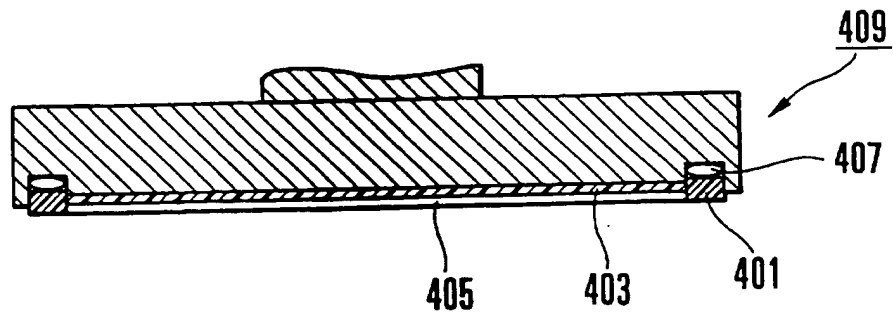


FIG. 4B

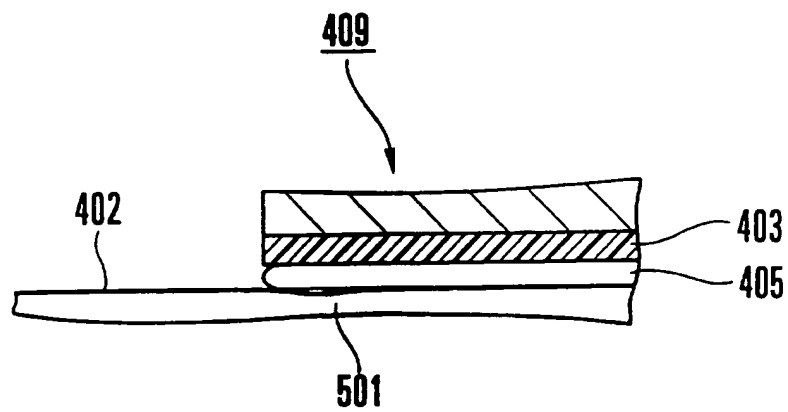


FIG. 5A

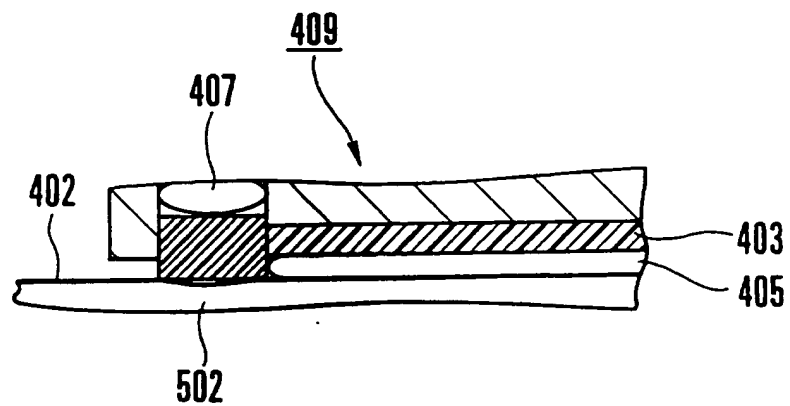


FIG. 5B

## Specification

## Title of the Invention

## Polishing Apparatus

5 Background of the Invention

The present invention relates to a polishing apparatus used in, e.g., chemical-mechanical polishing (CMP).

A technique for planarizing a substrate  
10 surface by polishing has been employed in many fields including the semiconductor substrate fabrication process. In recent years, CMP for planarizing the unevenness of a surface, e.g., the unevenness of the surface of an interlevel insulating film, formed during  
15 the fabrication by polishing is used in a process of fabricating devices on a semiconductor substrate.

In CMP, hard polishing cloth made of a material such as foamed polyurethane, different from relatively soft polishing cloth comprised of unwoven  
20 fabric used for polishing the surface of the semiconductor substrate, is used to planarize the insulating film. To obtain the polishing uniformity within the substrate surface, an elastic cushion layer is generally formed under a hard pad.

25 Figs. 4A and 4B show the arrangement of a conventional polishing apparatus.

As shown in Fig. 4A, the conventional

polishing apparatus is constituted by a substrate holder  
409 for holding a polishing target, a polishing table  
410 to which a polishing pad 402 is adhered, an abrasive  
supply member 411, and a conditioning mechanism 413 on  
5 which a diamond pellet 412 is mounted. Mechanisms  
provided to the substrate holder 409 and conditioning  
mechanism 413 to rotate, swing, and press them, and a  
rotational mechanism provided to the polishing table 410  
are not illustrated.

10 As shown in Fig. 4B, a retainer ring 401 is  
set on a surface of the substrate holder 409 which  
opposes a substrate 405, to correspond to the  
circumference of the substrate 405. The retainer ring  
401 holds the substrate 405 and prevents lateral shift  
15 of the substrate 405. As the material of the retainer  
ring 401, a hard plastic such as polyethylene  
terephthalate is used. An air cushion 407 applies a  
downward load to the retainer ring 401. An elastic  
layer called an insert pad 403 is formed on the surface  
20 of the substrate holder 409 inside the retainer ring 401.

By using the polishing arrangement having the  
above arrangement, for example, the surface of an  
interlevel insulating layer in the multilevel  
interconnection structure of an LSI is planarized.

25 During polishing, the retainer ring 401  
prevents not only lateral shift of the substrate 405 but  
also abnormal polishing of the outer peripheral portion







to suppress deformation, its mechanical strength is limited and inferior to that of a metal alloy material such as stainless steel. Even a conventional retainer ring using a hard plastic deforms when the number of polishing processes increases, and the capability of the retainer to press the polishing pad degrades. As a result, in the conventional polishing apparatus, when the number of polishing processes increases, an abnormality in polishing amount occurs on the outer peripheral portion of the substrate as a polishing target.

## Summary of the Invention

It is an object of the present invention to provide a polishing apparatus in which, even if the number of polishing processes increases, occurrence of an abnormality in polishing amount on the outer peripheral portion of the substrate as a polishing target is suppressed.

In a first aspect of the present invention, there is  
20 provided polishing apparatus comprising:

a polishing surface;

means for forcing a surface of a sample to be polished against said polishing surface; and



a retainer ring provided on said means for surrounding said substrate, said ring having a resin portion for contacting said polishing surface and holding means for holding said resin portion, said holding means having a higher mechanical strength than said resin portion.

In a second aspect of the present invention, there is provided a polishing apparatus comprising a polishing pad adhered to a polishing table, a substrate holder for urging, while holding a substrate as a polishing target, a polishing target surface of the substrate against the polishing pad, and a retainer ring formed on a holding surface of the substrate holder to correspond to a circumference of the substrate, the retainer ring having a resin portion formed on a surface thereof which is to come into contact with the polishing pad, and an annular resin holding portion for holding the resin portion and made of a material having a higher mechanical strength than the resin portion.

20

### Brief Description of the Drawings

Preferred features of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-









ring 101 has a two-layered structure constituted by the resin portion 101a and metal portion 101b. As a result, compared to a conventional case wherein the whole retainer ring is formed of a hard plastic, the mechanical strength of the retainer ring 101 increases considerably.

Of the retainer ring 101, only its resin portion 101a comes into contact with the polishing pad 102, and its metal portion 101b does not. Therefore, no metal component will spread over the polishing pad 102 to adversely affect the characteristics of devices formed on the substrate 105. Also, the polishing surface of the polishing table will not be damaged by the cutting chips of the metal material.

15           A practical example of polishing apparatus of  
this embodiment will be described.

In the polishing apparatus using the retainer ring 101, an 8-inch diameter silicon substrate formed with an oxide film on its surface was employed as a sample. The oxide film was removed by CMP. The thickness of the oxide film to be removed by polishing was set to about 650 nm. Under these conditions, 25 substrates were polished. When the 26th substrate was polished, a region where the polishing film thickness was smaller by about 20 nm to 30 nm was formed at a region of about 3 mm from the outer peripheral portion of the silicon substrate, as indicated by a curve (a) of







metal portion 311b need not be brought into tight contact with each other through an adhesive or the like. As a result, even when the resin portion 311a cannot be adhered to the metal portion 311b depending on combinations of the materials, the retainer ring 311 can be fabricated.

In the above embodiment, stainless steel is used to form the metal portion, and polyethylene terephthalate is used to form the resin portion.

10 However, the present invention is not limited to this, but the following engineering plastics may be used instead. More specifically, examples are polycarbonate, polyamide, polybutylene terephthalate, polysulfone, polyether sulfone, polyether ether ketone, polyamide

15 imide, polyether imide, a chlorotrifluoroethylene-ethylene copolymer, and the like.

The material of the metal portion is not limited to stainless steel, but a metal having a resistance to corrosion and a high mechanical strength, or its alloy may be used.

As has been described above, according to the present invention, since a resin is used to form only a surface of the retainer ring which is to come into contact with the polishing pad, a higher mechanical strength than that obtained when the entire retainer ring is made of only a resin can be obtained. As a result, even when the number of polishing processes





which is to come into contact with the polishing pad,  
and an annular resin holding portion for holding the  
resin portion and made of a material having a higher  
mechanical strength than the resin portion.

1. Polishing apparatus comprising:

means (109) for forcing a surface of a sample to be

a retainer ring (101, 301, 311) provided on said means

for surrounding said **substrate**, said ring having a resin portion (101a, 301a, 301b) for contacting said polishing

surface (102) and holding means (101b, 301a, 301b) for

holding said resin portion, said holding means having a

higher mechanical strength than said resin portion.

pad (102) adhered to a polishing table (110).

3. Apparatus according to Claim 1 or 2, wherein said

retainer ring has an internal diameter substantially equal

to the diameter of the sample to be polished.

a polishing pad (102) adhered to a polishing table

a substrate holder (109) for urging, while holding a

substrate (105) as a **polishing** target, a polishing target

25 surface of the substrate against said polishing pad; and

a retainer ring (101, 301, 311) formed on a holding

surface of said substrate holder to correspond to a

circumference of the substrate, said retainer ring having

a resin portion (101a, 301a, 301b) formed on a surface thereof which is to come into contact with said polishing pad, and an annular resin holding portion (101b, 301a, 301b) for holding said resin portion and made of a material having a higher mechanical strength than said resin portion.

5. An apparatus according to Claim 4, wherein said retainer ring has a two-layered structure formed by stacking said resin portion annularly on a surface of said resin holding portion which opposes said polishing pad.

6. An apparatus according to Claim 4, wherein said retainer ring has a molded structure in which an entire surface of said resin holding portion is covered with said resin portion.

7. An apparatus according to any of Claims 4 to 6, wherein said resin holding portion is formed from one of a metal and an alloy.

8. An apparatus according to Claim 7, wherein said resin holding portion is formed from stainless steel.

9. An apparatus according to any of Claims 4 to 8, wherein said resin portion is formed from a hard plastic.





Application No: GB 9908325.5  
Claims searched: 1-12

Examiner: R.B. Luck  
Date of search: 29 July 1999

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.Q): B3D DMN,DMW,DUH2

Int CI (Ed.6): B24B 37/04,41/06

Other:

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB1352932 H.Struers Chemiske Laboratorium	1-4,6,7

X Document indicating lack of novelty or inventive step  
Y Document indicating lack of inventive step if combined with one or more other documents of same category.  
& Member of the same patent family

A Document indicating technological background and/or state of the art.  
P Document published on or after the declared priority date but before the filing date of this invention.  
E Patent document published on or after, but with priority date earlier than, the filing date of this application.